

ANTIOXIDANT AND ANTIMICROBIAL EFFECTS OF GREEN TEA AND GRAPE SEED EXTRACTS ON BEEF PATTIES WITH A LOW DOSE OF SULPHITE

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Keywords: beef patties, natural antioxidants, sulphite, ascorbate, tea, grape

Introduction

EC Directive 95/2/EC authorises the addition of sulphites (up to 450mg/kg) in order to delay microbiological and colour spoilage in patties. The preservative action of sulphite is usually strengthened by ascorbate or other antioxidative additives. The use of sulphites in food is questionable because it is related to certain health problems, such as allergies, thiamine absorption deficit and disorders on the carbohydrate metabolism. Vegetable substances with preservative effect are an alternative for prolonging the shelf life of meat. Green tea and grape seed are rich in polyphenolic compounds and their antioxidative activity on lipids has been proven in raw and pre-cooked meat products (Gil *et al.*, 2001; Tang *et al.*, 2001; Lise *et al.*, 2004; Mielnik *et al.*, 2006). Other studies suggest that they may also have a certain antimicrobial effect (Jayaprakasha *et al.*, 2003). Previous studies (Díaz *et al.*, 2005) have shown that green tea and grape seed extract do not delay the colour deterioration of raw beef patties, unless sulphites are added, although they may contribute to a reduction in the dose of sulphites necessary. The aim of this study was to determine the effect of green tea and grape seed extracts on the shelf life of patties manufactured with a low level of sulphites (100mg/kg) and stored under retail display conditions.

Materials and Methods

Five batches of beef patties (minced to 5mm and 2% salt) were prepared: the control group, S100 (100mg/kg sulphites in the form of sodium metabisulphite), S100 + A400 (100mg/kg sulphites + 400mg/kg sodium ascorbate), S100 + T300 (100mg/kg sulphites + 300 mg/kg watery green tea extract) and S100 + G300 (100mg/kg sulphites + 300 mg/kg watery grape seed extract) (sodium metabisulphite and sodium ascorbate, Juan Martínez Pérez S.L., Spain; vegetable extracts, GMBH & Co. Kg, Germany). The patties were packed in the presence of air and stored for a maximum of 9 days at 4°C under natural lighting conditions. The spoilage of the meat was determined by colour change, expressed as Chroma and Hue (Minolta Chromameter Reflectance II), the Thiobarbituric Acid Reactive Substances (TBARs) index (mg Malondialdehyde (MDA)/kg meat) and the total viable count and total coliform count (log u.f.c./g) at days 0, 3, 6 and 9 of storage. In order to determine whether the extracts used had caused adverse effects in the meat, a trained panel of 10 judges carried out sensory analysis of the patties at day 0.

Results and Discussion

According to the TBARs values (Table 1), the 3 vegetable antioxidants tested were effective in delaying lipid oxidation in comparison with the control and S100 groups. The antioxidative effect on raw meat has also been described by Gil *et al.* (2001) (tea catechins), Lise *et al.* (2004) (green tea and grape skin), Mitsumoto *et al.* (2005) (vitamin C and tea catechins) and Mielnik *et al.* (2006) (grape seed). On the other hand, the 3 vegetable antioxidants tested had no stabilising effect on the colour above that of S100 (Table 1). Neither was there a greater antimicrobial effect than with S100 (Table 2). The antimicrobial capacity of ascorbate on minced buffalo meat has been questioned by Sahoo and Anjaneyulu (1997). Sensory analysis (Table 3) showed that none of the 3 vegetable extracts tested caused adverse odours or flavours in cooked meat, which agrees with the findings of Mitsumoto *et al.* (2005). Attributes with scores of less than 2 were rancid odour, rancid, liver, acid, astringent and metallic flavours.

Table 1: Average values of TBARs (TBA), Chroma (C*) and Hue (H*) in beef patties at 0, 3, 6 and 9 days under retail display conditions.

| | Day 0 | | | Day 3 | | | Day 6 | | | Day 9 | | |
|-----------|-------|------|------|-------------------|-------------------|--------------------|-------------------|--------------------|--------------------|-------------------|-------------------|-------------------|
| | TBA | C* | H* | TBA | C* | H* | TBA | C* | H* | TBA | C* | H* |
| Control | 0.83 | 17.3 | 22.8 | 2.47 ^a | 14.8 ^a | 28.5 ^a | 3.07 ^a | 13.2 ^a | 40.0 ^a | 3.86 ^a | 10.6 ^a | 44.1 ^a |
| S100 | 0.78 | 20.2 | 22.2 | 2.65 ^a | 19.5 ^b | 23.0 ^{ab} | 2.96 ^a | 15.1 ^{ab} | 30.5 ^b | 3.31 ^b | 11.7 ^a | 37.8 ^b |
| S100+A400 | 0.44 | 21.1 | 21.1 | 0.60 ^b | 20.3 ^b | 21.1 ^b | 0.78 ^b | 16.1 ^{ab} | 22.4 ^c | 0.69 ^c | 15.8 ^b | 26.0 ^c |
| S100+T300 | 0.51 | 21.5 | 21.0 | 0.84 ^b | 20.7 ^b | 22.4 ^b | 0.63 ^b | 17.4 ^b | 26.4 ^{bc} | 0.60 ^c | 15.3 ^b | 28.1 ^c |
| S100+U300 | 0.45 | 20.1 | 20.2 | 0.47 ^b | 21.2 ^b | 22.0 ^b | 0.45 ^b | 17.6 ^b | 24.3 ^{bc} | 0.47 ^c | 14.9 ^b | 30.6 ^c |

S: sulphite; A: ascorbate; T: green tea; G: grape seed.

Means with different superscripts (rows) are significantly different ($p < 0.05$).

Table 2: Average total viable count (TVC) and total coliform count (TCC) (log ufc/g) in beef patties at 0, 3, 6 and 9 days under retail display conditions.

| | Day 0 | | Day 3 | | Day 6 | | Day 9 | |
|-------------|-------|------|-------|------|--------------------|-------------------|-------|--------------------|
| | TVC | TCC | TVC | TCC | TVC | TCC | TVC | TCC |
| Control | 4.59 | 3.41 | 4.60 | 3.50 | 5.58 ^a | 4.71 ^a | 6.37 | 5.50 ^a |
| S100 | 4.46 | 3.29 | 4.44 | 3.50 | 5.18 ^{ab} | 3.53 ^b | 5.98 | 4.15 ^{ab} |
| S100 + A400 | 4.43 | 3.23 | 4.32 | 3.23 | 4.36 ^b | 3.21 ^b | 5.60 | 3.66 ^b |
| S100 + T300 | 4.31 | 3.34 | 4.55 | 3.28 | 4.49 ^b | 3.25 ^b | 5.81 | 3.82 ^b |
| S100 + G300 | 4.45 | 3.45 | 4.27 | 3.24 | 4.35 ^b | 3.25 ^b | 5.55 | 3.45 ^b |

S: sulphite; A; ascorbate; T: green tea; G grape seed.

Means with different superscripts (rows) are significantly different (p<0.05).

Table 3: Average values of sensory attributes in beef patties (day 0).

| Attributes | Control | S 100 | S 100 + A 400 | S 100 + U 300 | S 100 + T 300 |
|------------|---------|-------|---------------|---------------|---------------|
| MO | 3.90 | 3.67 | 3.77 | 4.05 | 3.82 |
| MF | 4.35 | 4.32 | 4.25 | 4.30 | 4.22 |
| FP | 2.70 | 3.02 | 2.87 | 2.85 | 2.87 |
| JU | 3.87 | 4.22 | 3.95 | 3.67 | 3.92 |
| CH | 3.85 | 3.75 | 3.70 | 4.05 | 3.97 |

S: sulphite; A; ascorbate; T: green tea; G grape seed.

Scoring scale: (1: minimum; 5: maximum)

MO: meaty odour; MF: meaty flavour; FP: persistent flavour; JU: juiciness; CH: chewiness.

Conclusions

The use of green tea and grape seed extracts delays fat oxidation and contributes to prolonging the shelf life of beef patties manufactured with reduced levels of sulphite and stored under usual retail display conditions. 300 mg/kg of green tea and grape seed extracts have a preservative action similar to that of 400 mg/kg sodium ascorbate. The doses of green tea and grape seed tested do not modify the sensory quality of cooked meat, therefore it is acceptable to add these natural antioxidants to meat products.

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